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December 2003

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### Recommended Citation

Boyes, James and Irani, Zahir, "Barriers and Problems Affecting Web Infrastructure Development: The Experiences of a UK Small Manufacturing Business" (2003). *AMCIS 2003 Proceedings*. 90.  
<http://aisel.aisnet.org/amcis2003/90>

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# BARRIERS AND PROBLEMS AFFECTING WEB INFRASTRUCTURE DEVELOPMENT: THE EXPERIENCES OF A UK SMALL MANUFACTURING BUSINESS

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## Abstract

*This paper empirically identifies the factors that restrict the Web infrastructure development process within UK Small Businesses. The paper provides a brief overview of the advantages and benefits that become available through the development of a commercial Web infrastructure, and notes that whilst these advantages and benefits are well documented, small businesses are often ill equipped to exploit them in pursuit of commercial gain. The reasons for this are considered to centre upon the barriers and problems these businesses encounter when attempting to exploit the Web for commercial gain. Consequently a summary of these barriers and problems is presented. The accuracy of this summary and its applicability as a tool with which to analyse and document the impact of the identified barriers and problems is then explored. To do so a case study research strategy is employed that utilises multiple data collection methods to analyse the on-line experiences of a UK small manufacturing business within the context of the framework presented within this paper. Based upon this case study and the paper's preliminary findings, further research work is then proposed that will build upon the analysis presented within this paper.*

**Keywords:** WWW, small business, Web infrastructure

## Introduction and Scope

Between 1996 and 1999, business use of the Internet and the development of commercial Web sites by UK organisations grew annually by 80% and 90% respectively (DTI 1999). By 2001 94% of all UK businesses were connected to the Internet and over 1.9 million Small and Medium Sized Enterprises (SMEs) had established a Web presence (DTI 1998, DTI 2001, Office of the E-Envoy 2002). However, whilst some authors argue that the commercial use of the Web is a strategy best suited to small (those organisations with 49 or fewer employees) rather than large businesses, many authors note that Small Businesses are routinely unable to realise the potential benefits and advantages that can become available to an organisation through the development of a Web infrastructure because of the barriers and problems they encounter when attempting to exploit the Web for commercial gain (Vescovi 2000, Anckar & Walden 2001, Sparkes & Thomas 2001, Carter *et al.* 2002). Consequently, a summary of these barriers and problems is presented. The accuracy of this summary and its applicability as a tool with which to analyse and document the impact of the identified barriers and problems is then explored. To do so a case study research strategy is employed that utilises multiple data collection methods to analyse the on-line experiences of a UK small manufacturing business within the context of the framework presented within this paper. Following a discussion of their findings the authors then introduce their

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current research project that will build upon the issues discussed within this paper. This project intends to supplement the analysis of the problems and barriers facing Small Businesses when they develop Web infrastructures with the development of coping strategies for use by other Small Businesses thereby helping them to overcome the numerous inter and intra organisational Web infrastructure problems and barriers discussed within this paper.

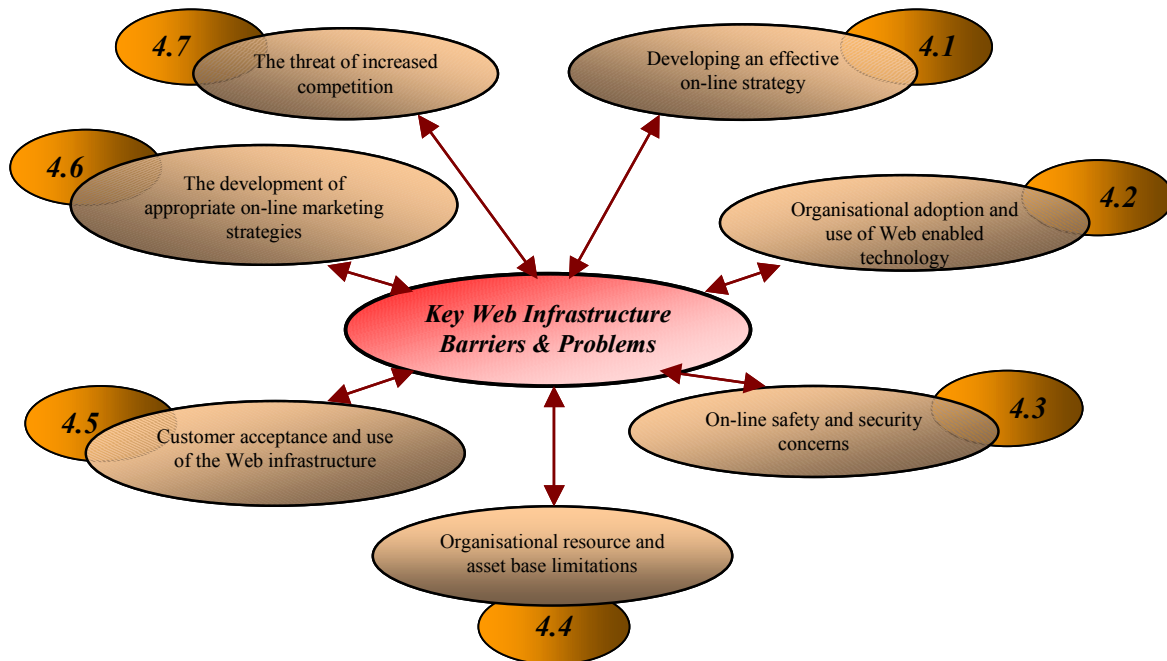
## The Beneficial Impact of the Use of the Web Upon an Organisation

The effective commercial use of the Web has the potential to radically change the way in which organisations communicate with their customers about the products and services they offer. A Web infrastructure can be used to support this strategy through being a low cost yet highly effective communications tool (Peppers & Rogers 1995). The effective use of the Web makes 'one-to-one' relationship marketing possible via an interactive medium that users find both stimulating and pleasurable (Shih 1998, Van Nierkirk *et al.* 1999). The interactivity between business and customer can subsequently be utilised by an organisation to more closely align its offerings to its customers' requirements, which in turn adds significant value for both parties. By collecting detailed and precise information about customer needs, organisations can create virtuous circles in which providing good customer service creates knowledge about customer behaviour thus improving customer service still further, fostering stronger relationships and through this, repeat sales (Hoffman *et al.* 1995, Hoffman & Novak 1996, Quelch & Klein 1996, Limehouse 1998, Sparkes & Thomas 2001). Moreover, the Web can enable an organisation to differentiate its products and services on these non priced-based value adding dimensions thereby maximising the prices that it ultimately charges its customers (Sparkes & Thomas 2001). Similarly, the effective use of the Web has the potential to radically change the way that companies do business since it can make a significant contribution to the components of a company's value-chain by improving their relationships with vendors and suppliers, and increasing the efficiency of their internal and external operations (Rayport & Sviokla 1994 & 1995, Lu & Yeung 1998, Yakhlef 1998). Likewise, the creation of a Web site offers an instant presence within global markets and can be an excellent vehicle through which to increase organisational sales and profits - over 38% of the UK's 35 million Internet users now regularly buy products and services on-line, whilst in 2001 UK e-sales totalled over £57bn (Howard 2001, MORI 2002, Office of the E-Envoy 2002). Furthermore, many authors conclude that the effective use of the Web can have the largest positive effect upon Small Businesses. The reason for this is the positive impact that its effective use can have upon this type of organisation's business operations (DTI 1998, UKOnline for Business 2000, Anckar & Walden 2001, Sparkes & Thomas 2001, Tetteh & Burn 2001, Carter *et al.* 2002, Jutla *et al.* 2002).

## The Barriers Faced by Small Businesses Using the Web for Commercial Purposes

Whilst the applicability of the use of a Web infrastructure by Small Businesses appears to be well documented, many authors argue that Small Businesses are often ill equipped to exploit this medium effectively (Chesher & Skok 2000, Vescovi 2000, Anckar & Walden 2001, Sparkes & Thomas 2001, Carter *et al.* 2002, Jutla *et al.* 2002). These authors maintain that Small Businesses often encounter 'barriers' that actively prevent them from initially developing an appropriate Web infrastructure whilst others experience a variety of 'problems' that curtail their ability to exploit their Web infrastructure in pursuit of commercial gain. As a result, UK Small Businesses are now less than half as likely as large UK organisations to use the Web since these barriers' existence dissuades a significant proportion from attempting to develop an infrastructure with which to exploit Web based technologies (Chapman *et al.* 2000, Chesher & Skok 2000). Similarly, as Jutla *et al.* (2002) note, many Small Businesses are simply unable to realise the potential benefits offered by the development of a Web infrastructure since they have only limited financial, physical and human resources and limited management, marketing and ICT knowledge and expertise with which to address the many problems that arise from the development of a Web presence. Consequently, it appears that the organisational benefits that can come from the development of a Web infrastructure are far from guaranteed for this sector.

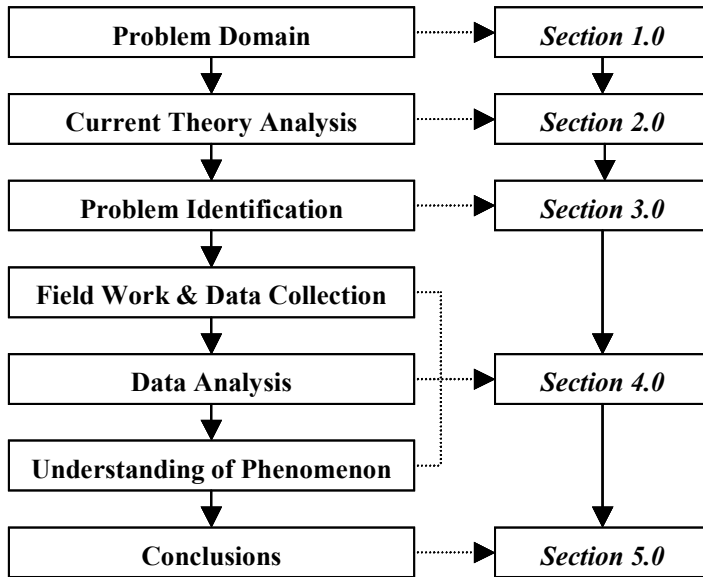
Cunliffe (2000), Martin & Matley (2001) and Mehrtens *et al.* (2001) argue that without further research many Small Businesses' future efforts to develop effective Web infrastructures will be unsuccessful. Consequently, the authors have previously analysed the barriers and problems that negatively impact upon the Web infrastructure development process of Small Businesses as documented within current literature. Boyes & Irani (2002) present an exhaustive analysis and discussion of these barriers and problems, and fully consider each identified barrier and problem's applicability to the Small Businesses sector. That analysis suggests that a Small Business developing a Web infrastructure is likely to face numerous barriers and problems both within and outside of its direct control. Figure 1 outlines the main problem and barrier categories previously identified by the authors (see Boyes & Irani (2002) for a full discussion of these barriers and problems, their applicability to the Small Business sector and an analysis of their likely impact upon the Web infrastructure development process) and indicates within which section (4.1 – 4.7) the case study organisation's relevant experiences are considered.



**Figure 1. Key Web Infrastructure Barriers and Problems**

Whilst the barriers and problems faced by Small Businesses when attempting to exploit a Web infrastructure for commercial gain appear diverse, it is possible to classify them based upon their broad characteristics into the above framework. Consequently this study's primary research objective was to use this framework (developed from Boyes & Irani (2002)) within the confines of a real world Small Business to establish whether the business had experienced those barriers and problems previously identified by Boyes & Irani (2002) since whilst the authors' previous study involved the identification and analysis of various barriers and problems to the Web infrastructure development process, these barriers' and problems' existence was not empirically confirmed. In achieving this research objective, this study attempts to contribute towards the growing body of knowledge surrounding Web infrastructure development and the commercial exploitation of the Web as experienced by UK Small Businesses.

To satisfy the research objective, a case study research strategy was adopted. Yin (1994) defines such a strategy as an empirical investigation into contemporary phenomena that exist and operate within a real-life context. This strategy was adopted since the data necessary to explore this research phenomenon would be predominantly rich in contextual meaning, thus providing the researcher with the required detailed understanding of the contextual phenomenon under investigation. In addition, and as advocated by Swartz & Boaden (1997), a case study strategy was adopted since there existed the need to uncover and analyse contextual factors and the relationships they share. It is only through investigating such factors within their real-world setting of a functioning Small Business that their complexity can be fully understood and explored. As advocated by Yin (1994) and Rowley (2002) multiple observational data collection methods were employed to triangulate the study data thereby corroborating the accuracy and veracity of the study findings. In total 10 key informant semi-structured interviews were conducted with the organisation's 2 Directors and the 2 Operational Managers who have designed and developed the organisation's Web presence over a two-year period (the authors have worked closely with the case study organisation since April 2001). The experiences, attitudes and opinions of these key personnel were probed via a series of informal individual and group discussions. The authors recorded the data captured during these discussions for future analysis and dissemination. Consequently, primary data collection was achieved via semi-structured inductive interviews with the organisation's Directors, Marketing Manager and Operations Manager since these staff have contributed to, or directly influenced, the development of the organisation's Web infrastructure. The data collected via these interviews and discussions was subsequently corroborated by researcher observation and document analysis (for example discussions regarding the continuing receipt of customer requests for product technical information discussed in Section 4.5 was corroborated by both researcher observation of such requests being received by the organisation and the physical existence of such requests). Finally, a draft copy of this research paper was made available to the interview subjects in order to confirm the accuracy with which the authors have captured, analysed and reported the subject's own world-views thereby minimising data and interpretation bias. Therefore, the overall research design closely mirrors that advocated by O'Donnell & Cummins (1999) and Sekaran (2000) as highlighted within Figure 2.



**Figure 2. The Research Design**

YES also intends to exploit the Web to provide on-line marketing/promotional material thereby reducing marketing costs, whilst simultaneously more accurately targeting those organisations identified as potential customers (Doherty *et al.* 1999, Hoffman & Novak 2000). Similarly, the organisation's traditional value streams were to be supplemented via the exploitation of their *virtual* assets (Rayport & Sviokla 1994 & 1995, Yakhlef 1998, Weiber & Kollmann 1998) through the provision of specialist information on-line (for example the provision of technical product specifications on-line to reduce ongoing operational costs and enhance the service delivered to the customer). However, whilst YES believes that its Web infrastructure has helped to reduce its marketing costs, it also believes that the barriers and problems that it has encountered have affected its on-line performance – indeed its Web infrastructure is now undergoing redevelopment. Thus YES was selected for study since it could potentially benefit from the deployment of a commercial Web infrastructure yet has also experienced problems in the realisation of its on-line objectives. Therefore the framework of barriers and problems presented in Section 3.0 has been used to present the study findings (Sections 4.1 – 4.7) discussed below.

### On-line Strategy

In common with many other Small Businesses (Chesher & Skok 2000, Anckar & Walden 2001) YES lacked the financial resources to deploy a transaction enabled Web infrastructure that offers users the facility to order and pay for products and services on-line. Consequently YES has been unable to deploy an infrastructure that directly increases and visibly contributes to organisational revenues and has largely failed to develop the coherent strategic plans against which its infrastructure's ongoing performance can be measured against (a requirement deemed vital for success by Poon & Swatman 1997, Patel & Irani 1999, Blackburn & Athayade 2000 and Clapham 2002). As a result, the infrastructure's contribution to the organisation's wider strategic goals remains difficult to quantify since on-line performance measurement is currently limited to the measurement of site/page impressions in an attempt to gauge user interest in both the Web infrastructure and the products and services it promotes. Whilst such performance figures do provide YES with an indication as to how often their infrastructure is accessed by Internet users, the infrastructure's contribution towards the organisation's wider long-term strategic plans remains difficult to quantify (a common problem discussed by Roberts 2000, Duhan *et al.* 2001, Irani *et al.* 2001 and Sparkes & Thomas 2001).

### Web Technology

Unlike many Small Businesses (Skinner 2000, UKOnline for Business 2000) YES initially experienced few problems with the adoption and use of Web technologies. This is understandable since the organisation's everyday activities involve the use of high-end PC technologies and software packages (e.g. CAD-CAM applications). However, in common with the findings of Doherty *et al.* (1999), Williams (2000) and Carter *et al.* (2002) who argue that Small Businesses routinely lack the ICT and requisite organisational knowledge needed to successfully exploit the Web, YES subsequently experienced problems in this area. For

## The Case Study Organisation

Yorkshire Electrical Services Ltd (YES) is a small UK manufacturing company with both domestic and overseas customers. The company was formed in 1980, currently employs 16 staff and reported pre-tax profits of GBP 30,000 (from an annual turnover of GBP 500,000) in 2001. YES offers their predominantly industrial clients highly bespoke product design and development services and operate primarily within the product prototyping and electrical control panel markets. YES initially developed its Web infrastructure in April 2001 in response to its 2 Owner/Director's desires to improve the organisation's financial performance and to further enhance and portray the image of an organisation that is at the forefront of technological developments. Its Directors and staff perceive that they have already experienced some success in meeting these broad objectives. In accordance with Auger & Gallagher (1997), Kiani (1998), Webb & Sayer (1998), Vescovi (2000) and Poon & Joseph (2001), its products and services appear well suited to the on-line arena due to their specialised and bespoke nature, whilst

example the high cost of broadband Internet access has greatly reduced their desire to exploit the Web as a commercial channel (in common with over 50% of UK businesses, YES still access the Internet via a dial-up connection (Office of the E-Envoy 2002)), whilst the organisation's Owner/Managers' perceptions that Web, PC and software technologies evolve and change rapidly has resulted in the long-term use of 'tried and tested' hardware and software packages. Consequently their failure to realise the organisational benefits originally envisioned by the organisation has arguably been caused by all development work being undertaken 'in house' using unsophisticated Web site design software packages. Thus their experiences support the findings of Chesher & Skok (2000), Boyes *et al.* (2002) and Intel (2002) who note that the rapid rate of technological change makes maintaining ones' knowledge of new ICT time-consuming and overly onerous for many Small Business Owner/Managers. As a result, failure to do so routinely results in the development of inherently functionally limited infrastructures.

### ***On-line Security***

In accordance with the findings of Hoffman *et al.* (1999), Hatch (2000), Udo (2001) and Carter *et al.* (2002), YES' concerns regarding providing their infrastructure's users with adequate levels of on-line security has directly influenced their decision not to develop a transaction enabled Web infrastructure and has greatly reduced their desire to purchase products via the Web. Whilst these perceptions might be unfounded, in accordance with Palumbo & Herbig (1998) and Rowley (1999), their existence has greatly limited both the range of on-line features offered to their customers and the way in which YES uses the Web to interact with other members of its value chain, potentially both to their own and their customers' detriment.

### ***Resource Limitations***

In accordance with Taylor *et al.* (2001) and Jutla *et al.* (2002), YES' resource and asset base has greatly impacted upon their Web infrastructure's development. As noted above, limited financial resources resulted in all development work being undertaken by YES employees in order to minimise development costs. However the lack of specialist ICT staff and the organisation's inability to employ a specialist Web designer greatly increased the burden placed upon already stretched personnel whilst time and budgetary constraints precluded securing external training to address the organisation's skill shortages. The case study organisation's experiences demonstrate that whilst undertaking development work in-house can reduce an infrastructure's direct costs, this approach can greatly increase the indirect costs associated with the project. As a result, the organisation now perceives that the Web infrastructure ultimately developed by them is relatively unsophisticated in nature and limited in functionality. The case study organisation's experiences appear to support the findings of Anckar & Walden (2001), Taylor *et al.* (2001) and Clapham *et al.* (2002) who argue that limited financial resources will greatly limit the sophistication of an organisation's Web infrastructure whilst simultaneously preventing development work being outsourced or compensatory third-party training being secured.

### ***Customer Acceptance***

As advocated by Attaran (1999), Cunliffe (2000), Macpherson (2000) and Geissler (2001), YES attempted to involve their infrastructure's intended users within the development process. Securing their input to the project, however, proved problematic. Despite receiving regular requests for their Web site URL, when YES contacted their customers to enquire what information and functionality should be included within the desired site, their requests were met largely with apathy – many customers commented that they were unwilling to devote any time to assisting YES with the development of a Web infrastructure despite the time requirement being low (YES planned to capture their customers' requirements via brief telephone discussions and a 'draft' Web site) and the resulting Web infrastructure being potentially more closely aligned to their individual requirements. Furthermore, some of the features requested by those who did respond were beyond the organisation's programming ability or were subsequently excluded due to budgetary constraints or organisational resistance (e.g. the provision of transactional functionality). Consequently, during the infrastructure's initial development YES was left with no choice but to 'second guess' its proposed site's users' requirements with arguably limited success since user interaction with the Web infrastructure has been low. For example YES believed that new or potential customers would value a 'contact us' on-line form and therefore included this within the site yet to date only several on-line enquiries have been received. Likewise customers continue to attempt to use traditional channels rather than the Web infrastructure to interact with YES despite this being potentially more convenient for both parties. For example customers still routinely request product technical information by phone or fax despite YES having publicised the on-line availability of this information for the last 2 years. Indeed many of those who continue to request this information as 'hard copy' are those who initially requested this very on-line feature, since they ultimately use this information in digital form within their

own promotional/marketing literature. Consequently whilst YES intended to develop an infrastructure that would deliver easily quantifiable time and cost savings to its owners whilst simultaneously offering users a more convenient means of interaction with the organisation (e.g. the infrastructure would negate the time and effort spent by customers repeatedly requesting product information via phone or fax and nullify YES' need to repeatedly provide such information) they now perceive that the infrastructure has failed to meet this objective. Their customers use the Web infrastructure to interact with YES only when *they perceive* an advantage in doing so yet also appear reluctant to either assist YES in further developing the infrastructure so that it delivers more value to them or in using the features and functionality it already provides. Thus YES' customers' resistance to the adoption and use of their Web infrastructure has greatly limited the positive impact that the Web infrastructure has had upon YES and the contribution that it has made to the organisation. Consequently the case study organisation's experiences graphically highlight (in accordance with Roberts (2000)) that whilst customers may expect a Small Business to maintain a sophisticated Web infrastructure, they will use it only when this benefits them rather than the infrastructure's owners.

### Marketing Issues

In common with many Small Businesses (Venkatesh 1998, Poon & Joseph 2000 & 2001, Vescovi 2000, Taylor *et al.* 2001), YES lacks in-house marketing expertise. Whilst YES initially believed that the Web could be used to market its products and services more effectively, its failure to integrate its on-line marketing efforts within its wider marketing strategies has highlighted to customers the apparently disjointed nature of its communications (for example the Web site presents highly technical product information that YES now believes is unlikely to appeal to, or even make sense to, their targeted market of non-technical organisational buyers). Likewise, in accordance with Hoffman & Novak (1996, 1996b), Quelch & Klein (1996), Strader & Shaw (1999) and Hart *et al.* (2000), YES has found the Web to be an *in-active* (rather than *pro-active*) marketing tool, since within this medium it is the user who ultimately chooses and controls which marketing communications with which to interact. Consequently YES perceives the success of its on-line marketing efforts to be largely outside of its own control (in that the final decision as to whether a user will interact with the Web infrastructure ultimately rests with the user and not with YES) and now believes that this explains the relative failure of the Web infrastructure to fulfil the on-line marketing objectives originally devised.

### Online Competition

As noted by Porter (2001), Sparkes & Thomas (2001) and Clapham (2002), YES has found it difficult to differentiate its products and services on-line. In common with many Small Businesses, its differentiation strategy has been built around the close personal service it offers to customers, yet YES has found it difficult to promote or replicate these intangible 'value-adding' features on-line. Rather than offering YES an ideal opportunity to differentiate itself from its larger competitors and maximise the price charged for its services, its Web infrastructure has prompted it to further attempt to market itself on price alone, since this is the only 'feature' that YES is able to actively 'promote' on-line. Likewise its infrastructure now makes it possible for YES to bypass many of its industrial customers and retail its products and services directly to the final customer (thereby acting as *Value Chain Pirates* (Walters & Lancaster 1999, Sparkes & Thomas 2001)). Yet this strategy has been avoided, since YES views it as 'high risk' – if pursued unsuccessfully the damage caused to its real world relationships with existing customers could prove irreparable thus jeopardising YES' future. However this decision has itself caused YES problems. Since many YES products are subsequently re-sold by YES customers, YES' customers are highly reluctant to advertise to their own customer base that they are re-sellers/distributors rather than manufacturers. Consequently several of YES customers now perceive the organisation's attempts to market its products and services via the Web as a direct threat to their own continued success since these customers incorrectly believe that YES is attempting to capture business from their own customer base. This in turn could explain why their infrastructure has been met with apparent resistance on the part of the customer base, and why YES has found it so difficult to develop the 'brand' image it now desires (since to appease the concerns of its customers regarding *Value Chain Piracy* it cannot directly promote or advertise the products it manufactures!).

### Conclusions and Directions for Further Work

To test the framework presented in Section 3.0 the on-line experiences of 1 UK Small Business manufacturer have been examined via a series of semi-structured key informant interviews and researcher observation. The study findings have shown that:

- the organisation has encountered a wide variety of barriers and problems to the commercial exploitation of the Web

- the case study organisation's experiences support the authors' proposition that the on-line barriers and problems facing a Small Business are accurately detailed by the framework presented in Section 3.0
- the framework developed by the authors appears suitable for use to analyse the on-line experiences of other Small Businesses

The authors intend to further refine this framework to develop coping strategies for use by other Small Businesses. The project will analyse the experiences of a diverse group of UK Small Businesses that have already established Web infrastructures to help those other UK Small Businesses that have yet to establish a presence on the Web or those who remain dissatisfied with the on-going performance of their Web infrastructure. A case study research strategy will be utilised since (as Yin (1994) and Jankowicz (2000) note) it is particularly suitable when the primary research objective is to analyse a contextual phenomenon that existing theory and knowledge does not adequately address or explain. Consequently in relatively less well-known areas, where there is little experience or theory to serve as a guide, the intensive study of selected examples is a highly practical way of gaining insight, collecting 'rich' primary data and suggesting hypotheses for further research (Ghauri *et al.* 1995). The use of a comparative case study research methodology is proposed since this will allow the authors to investigate the problems and barriers curtailing the commercial use of the Web by Small Businesses across multiple organisations in great detail within a relatively small time frame and accurately identify the factors and interrelated processes affecting the organisations concerned (Cryer 2000). Consequently, given its apparent applicability to the research objectives detailed above, a comparative case study research method has been chosen for use within the research project. This research methodology will enable the authors to build upon their preliminary research work to identify and explore the cross-organisational variables of interest thereby facilitating the further analysis of the relationships they share. Thus within this interpretivist paradigm the authors' proposed approach centres upon insight and exploration rather than upon experimentation and the statistical analysis of data. Their overall aim is to gain a deep understanding of the Small Business Web infrastructure development process (and the barriers and problems inherent within it) and from this develop further knowledge about this particular phenomenon via the careful and systematic analysis of the features and characteristics of the organisations studied.

Consequently, the research findings are intended to be of practical use to other UK Small Businesses since they will highlight to them not only what problems and barriers they are likely to experience when they attempt to develop a Web infrastructure but will also detail how these problems might be avoided. The future dissemination of the study findings will offer practical guidance to the UK Small Business sector and will help to bridge the gap that, based upon the authors' experiences of working within this sector, appears to currently exist between academic research into the exploitation of the Web for commercial gain and the application and utilisation of this research by UK Small Businesses.

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